

Amendments to the Specification:

Please add the following paragraph beginning at Page 1, line 2:

**STATEMENT REGARDING FEDERALLY-SPONSORED
RESEARCH/DEVELOPMENT**

This invention was made with Government support under contracts N00014-95-C-0278 and N00014-96-C-0395 awarded by the Office of Naval Research. The Government has certain rights in the invention.

Please replace the paragraph at page 15, starting at line 19, with the following:

The furnace 110 may be any suitable device for heating the aerosol 108 to evaporate liquid from the droplets of the aerosol 108 and thereby permit formation of the particles 112. The maximum average stream temperature, or reaction temperature, refers to the maximum average temperature that an aerosol stream attains while flowing through the furnace. This is typically determined by a temperature probe inserted into the furnace. Preferred reaction temperature according to the present invention are discussed more fully below. According to one embodiment, the reaction temperature is from about 500°C to about 1400°C.

Please replace the paragraph at page 31, starting at line 9, with the following:

The excess carrier gas 238 that is removed in the aerosol concentrator 236 typically includes extremely small droplets that are also removed from the aerosol 108. Thus, droplets can be removed that have an aerodynamic diameter less than a preselected minimum diameter. Preferably, the droplets removed with the excess carrier gas 238 have a weight average size of smaller than about 1.5 μm , and more preferably smaller than about 1 μm and the droplets retained in the concentrated aerosol 240 have an average droplet size of larger than about 2 μm . For example, a virtual impactor sized to treat an aerosol stream having a weight average droplet size of about three μm might be designed to remove with the excess carrier gas 238 most droplets smaller than about 1.5 μm in size. Other designs are also possible. When using the aerosol generator 106 with the present invention, however, the loss of these very small droplets in the aerosol concentrator 236

more than about 5 percent by weight, of the droplets originally in the aerosol stream that is fed to the concentrator 236. Although the aerosol concentrator 236 is useful in some situations, it is normally not required with the process of the present invention, because the aerosol generator 106 is capable, in most circumstances, of generating an aerosol stream that is sufficiently dense. So long as the aerosol stream coming out of the aerosol generator 102 is sufficiently dense, it is preferred that the aerosol concentrator not be used. It is a significant advantage of the present invention that the aerosol generator 106 normally generates such a dense aerosol stream that the aerosol concentrator 236 is not needed. Therefore, the complexity of operation of the aerosol concentrator 236 and accompanying liquid losses may typically be avoided.

Please replace the paragraph at page 36, starting at line 22, with the following:

Thus, droplets can be removed that have an aerodynamic greater than a preselected maximum diameter. In a preferred embodiment of the present invention, the droplet classifier 280 is typically designed to remove droplets from the aerosol 108 that are larger than about 15 μm in size, more preferably to remove droplets larger than about 10 μm in size, even more preferably to remove droplets of a size larger than about 8 μm in size and most preferably to remove droplets larger than about 5 μm in size. The droplet classification size in the droplet classifier is preferably smaller than about 15 μm , more preferably smaller than about 10 μm , even more preferably smaller than about 8 μm and most preferably smaller than about 5 μm . The classification size, also called the classification cut point, is that size at which half of the droplets of that size are removed and half of the droplets of that size are retained. Depending upon the specific application, however, the droplet classification size may be varied, such as by changing the spacing between the impactor plate 302 and the flow control plate 290 or increasing or decreasing aerosol velocity through the jets in the flow control plate 290. Because the aerosol generator 106 of the present invention initially produces a high quality aerosol 108, having a relatively narrow size distribution of droplets, typically less than about 30 weight percent of liquid feed 102 in the aerosol 108 is removed as the drain liquid 284 in the droplet classifier 288, with preferably less than about 25 weight percent being removed, even more

preferably less than about 20 weight percent being removed and most preferably less than about 15 weight percent being removed. Minimizing the removal of liquid feed 102 from the aerosol 108 is particularly important for commercial applications to increase the yield of high quality particulate product 116. It should be noted, however, that because of the superior performance of the aerosol generator 106, it is frequently not required to use an impactor or other droplet classifier to obtain a desired absence of oversize droplets to the furnace. This is a major advantage, because the added complexity and liquid losses accompanying use of an impactor may often be avoided with the process of the present invention.

Please replace the paragraph at page 57, starting at line 21, with the following:

Metal sulfide phosphors ($MS:M'$) can be prepared from an aqueous solution by the reaction of a metal compound such as a carbonate, oxide, hydroxide, sulfate or nitrate with a sulfur-containing acid such as thioacetic acid, thiocarboxylic acid ($HS(O)CR$) or dithiocarboxylic acid, to form a water soluble complex, such as $M(S(O)CR)_2 \cdot xH_2O$ (where R is an alkyl group). The complex can also be formed from a soluble metal salt and sulfur-containing ligand such as thiourea. Similar precursors can be used for the activator ion. Preferably, at least about 2 equivalents of acid are added to ensure complete reaction with the metal compound. The solution, when pyrolyzed under N_2 , leads to the metal sulfide.

Please replace the paragraph starting at page 60, line 1, with the following:

$SiCl_4$ also is highly volatile and is a liquid at room temperature, which makes transport into the reactor more controllable. Aluminum trichloride can be used as a volatile coating precursor in a similar manner.

Please replace the paragraph at page 65, starting at line 14, with the following:

In addition, the present invention provides the unique ability to produce mixed-metal sulfides of the general form $M^1_{1-x}M^2_xS$ (M^1, M^2)S, wherein M^1 and M^2 are Group 2 metals (e.g. $Mg_{1-x}Sr_xS$ or $Ca_{1-x}Sr_xS$ (Mg, Sr)S or (Ca, Sr) S) or wherein M^1 and M^2 are Group 12 metals (e.g. $Zn_{1-x}Cd_xS$ (Zn, Cd)S). Complex mixed metal sulfides, for example $Ba_xSr_yCa_{4-x-y}S$

yS (Ba,Sr,Ca)S can also be produced. This unique feature of the present invention enables the formation of phosphors having luminescence characteristics that are selectively controllable. For example, any color from orange to red can be selected by varying the ~~value of x~~ ratio of Ca to Sr in the mixed metal sulfide ~~$Ca_xSr_{1-x}S:Eu$~~ $(Ca,Sr)S:Eu$. Likewise, any color from green to yellow can be selected by varying the ~~value of x~~ ratio of Ca to Ba in the mixed metal sulfide ~~$Ca_xBa_{1-x}S:Ce$~~ $(Ca,Ba)S:Ce$ and any color from blue-green to green can be selected by varying the ~~value of x~~ ratio of Ca to Sr in the mixed metal sulfide ~~$Ca_xSr_{1-x}S:Ce$~~ $(Ca,Sr)S:Ce$.

Please replace the paragraph at page 65, starting at line 24, with the following:

Other sulfur-containing phosphor compounds that can be produced according to the present invention include thiogallates of the form MGa_2S_4 $M^3Ga_2S_4$ wherein M M^3 can be Ca, Sr, Ba, Mg or mixtures thereof. Such compounds are typically doped with Cu,Ga a rare-earth as an activator ion. Preferred examples include $SrGa_2S_4:Eu$ (green), $SrGa_2S_4:Ce$ (blue), $CaGa_2S_4:Eu$ and $CaGa_2S_4:Ce$ (blue-green). As with the mixed-metal sulfides, mixed metal thiogallates can be produced, such as ~~$Ca_xSr_{1-x}Ga_2S_4$~~ $(Ca,Sr)Ga_2S_4$. Further, thiogallates include compounds wherein aluminum or indium substitute for gallium in the structure, such as ~~$CaAl_xGa_{2-x}S_4$, $CaIn_xGa_{2-x}S_4$, $SrAl_xGa_{2-x}S_4$ or $CaAl_xGa_{2-x}S_4$~~ $Ca(Al,Ga)_2S_4$, $Ca(In,Ga)_2S_4$, $Sr(Al,Ga)_2S_4$ or $Sr(In,Ga)_2S_4$. The substitution of various amounts of aluminum or indium for gallium can advantageously adjust the chromaticity (color) of the phosphor compound.

Please replace the paragraph at page 66, starting at line 9, with the following:

In addition, oxysulfides, particularly $Y_2O_2S:Eu$ and rare-earth oxysulfides such as $Gd_2O_2S:Tb$ and $La_2O_2S:Tb$ can also be produced in accordance with the present invention. Such oxysulfides can be doped with from about 0.02 to about 15 atomic percent of an activator ion selected from the group consisting of rare-earth elements, Cu, Mn, Ag, Al, Au, Cl, Ga and mixtures thereof. Some preferred sulfur-containing phosphor host materials and activator ions are listed in Table I.

Please replace Table 1 at page 66 with the following:

TABLE I Examples of Sulfur-Containing Phosphors

Host Material	Activator Ion	Color
BaS	Ce	Yellow
CaS	Ce	Green
CaS	Mn	Yellow
SrS	Ce	Blue-Green
$Mg_xSr_{1-x}S$ (Mg,Sr)S	Ce	Blue-Green
ZnS	Cu	Blue-Green
Y_2O_2S	Eu	Red
$SrGa_2S_4$	Eu	Green
$SrGa_2S_4$	Ce	Blue

Please replace the paragraph at page 68, starting at line 8, with the following:

Although discussed herein with reference to thiogallates, it will be appreciated that other sulfur-containing phosphors, including ZnS, CdS, SrS or CaS, could be produced using a similar spray-conversion process. Thus, the precursors, such as nitrate salts, can be spray-converted at a temperature of, for example, 700°C to 800°C to form oxides or sulfides having low crystallinity. The intermediate product can then be roasted under H₂S gas at a temperature of, for example, 800°C to 1100°C, to form the metal sulfide phosphor compounds or thiogallate compounds. The phosphor particles can be further annealed to increase crystallinity of the particles and can be lightly milled to remove agglomerates.

Please replace the paragraph at page 73, starting at line 3, with the following:

The coating can be a metal, metal oxide or other inorganic compound such as a metal sulfide or oxysulfide, or can be an organic compound. For example, a metal oxide

coating can advantageously be used, such as a metal oxide selected from the group consisting of SiO_2 , MgO , Al_2O_3 , ZnO , SnO_2 , SnO , ZrO_2 , B_2O_3 , B_2O_3 , Bi_2O_3 , TiO_2 , CuO , Cu_2O , In_2O_3 or $\text{In}_x\text{Sn}_{1-x}\text{O}_2$ ($(\text{In},\text{Sn})\text{O}_2$). Particularly preferred are SiO_2 and Al_2O_3 coatings. Semiconductive oxide coatings such as SnO_2 or In_2O_3 can be advantageous in some applications due to the ability of the coating to absorb secondary electrons that are emitted by the phosphor. Metal coatings, such as copper, can be useful for phosphor particles used in direct current electroluminescent applications, discussed hereinbelow. In addition, phosphate coatings, such as zirconium phosphate or aluminum phosphate, can also be advantageous for use in some applications.

Please replace the paragraph at page 85, starting at line 18, with the following:

Particularly preferred phosphors for use in electroluminescent display applications include the metal sulfides such as $\text{ZnS}:\text{Cu}$, $\text{BaS}:\text{Ce}$, $\text{CaS}:\text{Ce}$, $\text{SrS}:\text{RE}$ (RE = rare earth), and $\text{ZnS}:\text{Mn}$. Further, mixed metal sulfides such as ~~$\text{Sr}_x\text{Ca}_y\text{Ba}_{1-x-y}\text{S}:\text{Ce}$~~ $(\text{Sr},\text{Ca},\text{Ba})\text{S}:\text{Ce}$ can be used. Further, the thiogallate phosphors according to the present invention can also have advantages for use in electroluminescent displays.

Please replace the paragraph at page 87, starting at line 19, with the following:

As discussed above, preferred electroluminescent sulfur-containing phosphors for use in electroluminescent lamps include $\text{ZnS}:\text{Cu}$ for blue or blue-green and $\text{ZnS}:\text{Mn}$, Cu for orange. Other materials that are desirable for EL lamp applications include $\text{BaS}:\text{RE}$, Cu or Mn, $\text{CaS}:\text{RE}$ or Mn, $\text{SrS}:\text{RE}$ or Mn, and ~~$\text{Sr}_x\text{Ca}_y\text{Ba}_{1-x-y}\text{S}:\text{RE}$~~ $(\text{Sr},\text{Ca},\text{Ba})\text{S}:\text{RE}$ (where RE is a rare earth element) for other colors. $\text{CaS}:\text{Ga}$ or Cu and $\text{SrS}:\text{Ga}$ or Cu are also useful. The thiogallate phosphors of the present invention, such as SrGa_2S_4 and CaGa_2S_4 , can be particularly advantageous for use in electroluminescent lamps. As is discussed above, many of these phosphors cannot be produced using conventional techniques and therefore have not been utilized in EL lamp applications. When used in an EL lamp, these phosphors should be coated to prevent degradation of the phosphor due to hydrolysis or other adverse reactions. Preferably, such a coating has an average thickness of from about 2 to 50 nanometers.

Please replace the paragraph at page 95, starting at page 14, with the following:

Thus, mixed metal sulfide phosphors can be produced in accordance with the present invention. Other examples of mixed metal sulfides which were produced in accordance with this example include $\text{Ca}_{1-x}\text{Sr}_x\text{S}$ and $\text{Mg}_{1-x}\text{Sr}_x\text{S}$ $(\text{Ca,Sr})\text{S}$ and $(\text{Mg,Sr})\text{S}$.